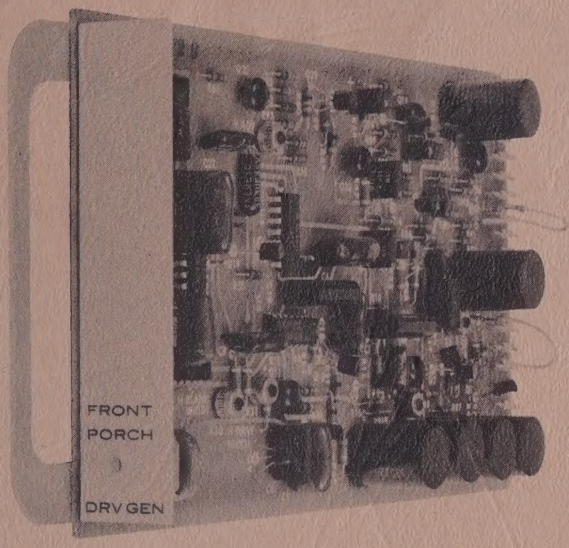
Technical Manual
Code No. 6X-450



OPERATING AND MAINTENANCE INSTRUCTIONS FOR

DRIVE GENERATOR

MODEL 3200-600
MODEL 3900-900

Box 623 / San Diego, California 92112 / Phone (714) 277-6700

COHU
ELECTRONICS, INC
SAN DIEGO DIVISION

Technical Manual
Code No. 6X-450

OPERATING AND MAINTENANCE INSTRUCTIONS FOR MODEL 3200-600 DRIVE GENERATOR

SERIAL NUMBER EFFECTIVITY: 5-0001 AND HIGHER

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Section I
GENERAL DESCRIPTION

1-1. INTRODUCTION

The COHU Drive Generator, Model 3200-600 (Figure 1-1), is a plug-in TV accessory used in the 3200 Series High-Resolution Self-Contained TV Cameras and 3900 Series High-Resolution Camera Controls with serial numbers 6-0851 and higher.

The drive generator provides all pulses required by monochrome TV broadcast studios or 525-line closed-circuit TV systems from a single mixed sync or composite video feed. The pulses are shaped to EIA RS-170 specification and include mixed sync, blanking, vertical and horizontal drive. Amplitude of the pulses is fixed at a nominal 4 volts peak-to-peak, but the widths of the pulses are adjustable, as is the timing of horizontal sync with respect to the leading edge of the horizontal blanking pulse. This adjustment is commonly called the front porch width.

The drive generator is constructed on a rectangular shaped printed circuit board with solid state electronic components, including both transistors and integrated circuits. The board dimensions are 4-1/2 inches wide and 8 inches long. A connector at the back of the board mates with the appropriate receptacle in the camera or control enclosure. The front panel of the board contains one control, FRONT PORCH.

1-2. GENERAL DESCRIPTION

A simplified block diagram and waveforms of the drive generator are shown in Figure 1-2. One input signal is required for operation, which can be either composite video or mixed sync. The input sync or composite video signal is first applied to the sync separator section where the video information is removed, if the input is composite video, and the sync portion of the remaining signal is separated into its vertical and horizontal components. With the separated sync signals the drive generator produces the blanking, vertical drive and horizontal drive pulses that are supplied at the output terminals.

1-3. SPECIFICATIONS

Performance and physical specifications of the drive generator are listed in Table 1-1.

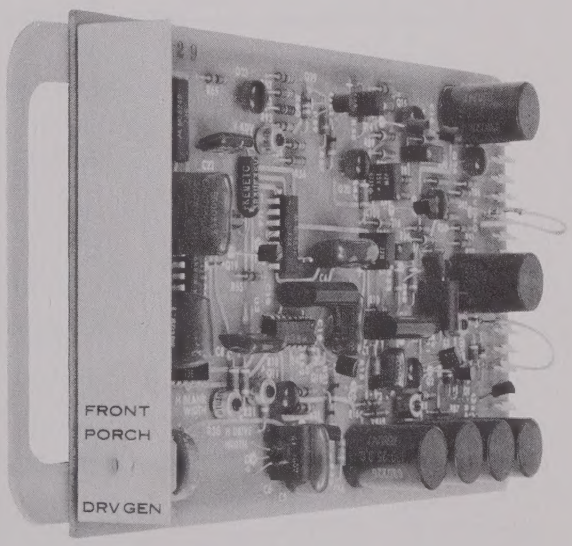
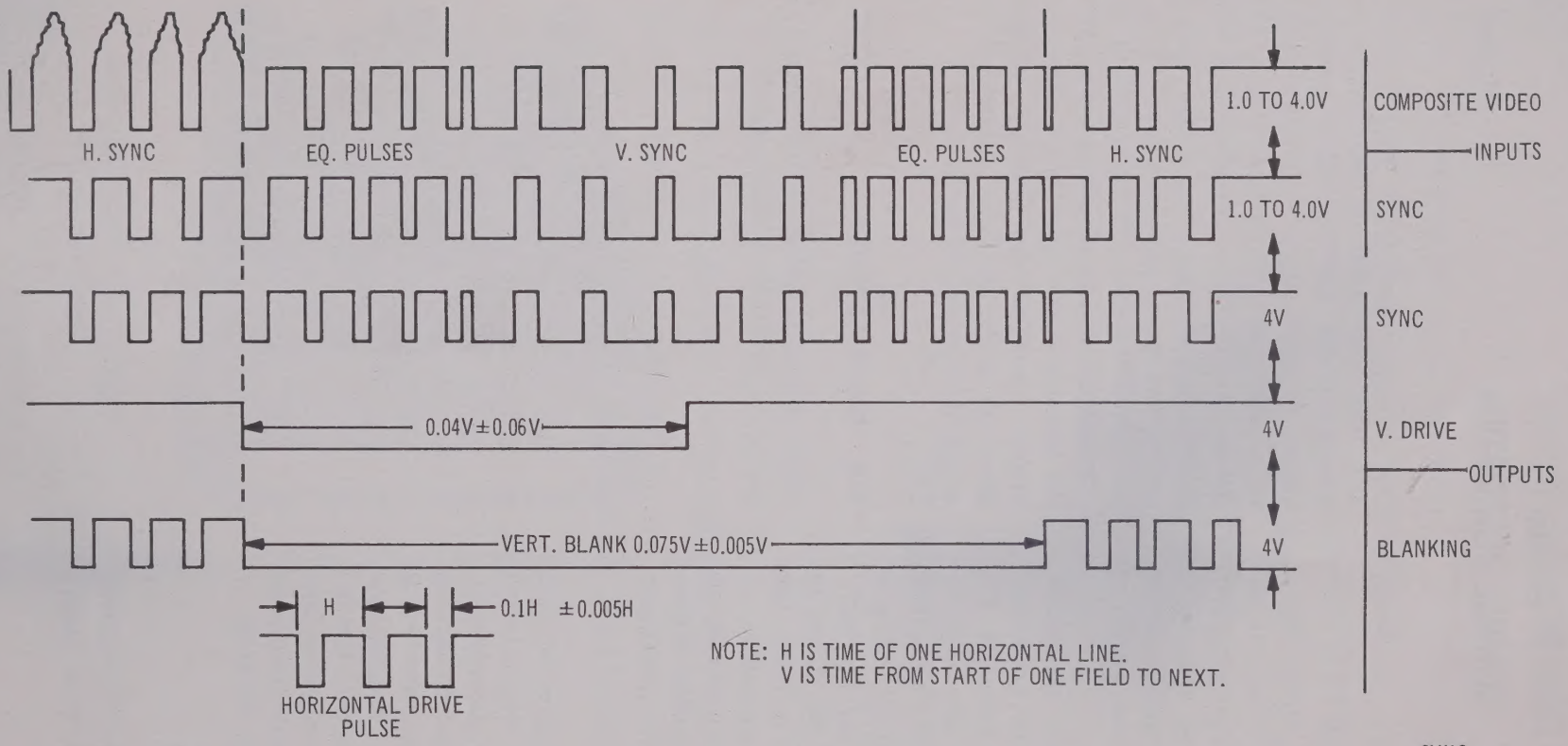


Figure 1-1. Model 3200-600 Drive Generator



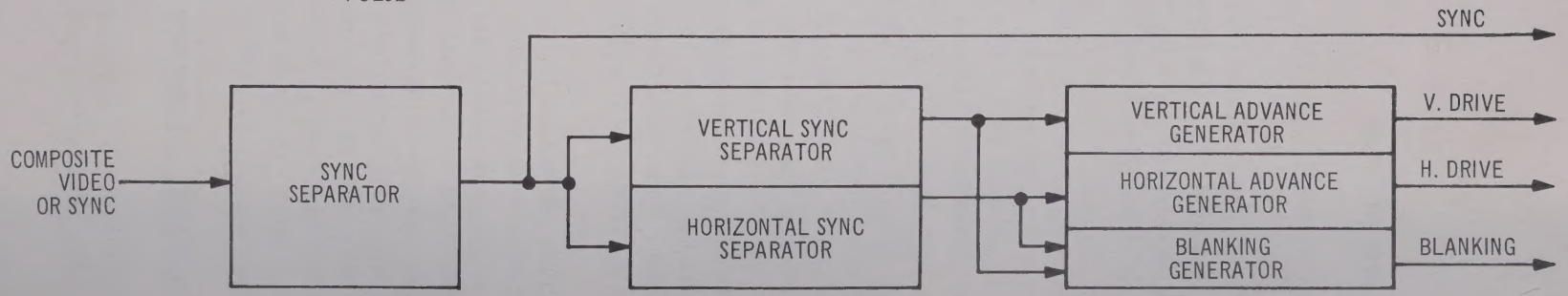


Figure 1-2. Drive Generator Simplified Block Diagram

Table 1-1. Specifications

INPUT REQUIREMENTS	
SIGNALS (conforming to EIA standard RS-170)	Composite video, 0.7 to 1.0 volt p-p negative-going, for 525-line scan, into high impedance for bridging, or; Mixed sync, 1.0 to 4.0 volts p-p, negative-going, for 525-line scan, into high impedance
POWER	+20, +3.6, -10V dc. Provided by power supply in enclosure
OUTPUTS	
MIXED SYNC	Nominal 4 volts p-p, negative-going, into 75-ohm line, for 525-line scan
MIXED BLANKING	Nominal 4 volts p-p, negative-going, into 75-ohm line, for 525-line scan. Both vertical and horizontal blanking pulse widths are adjustable
VERTICAL DRIVE	Nominal 4 volts, p-p, negative-going, into 75-ohm line. Pulse width is adjustable
HORIZONTAL DRIVE	Nominal 4 volts, p-p, negative-going, into 75-ohm line, for 525-line scan. Pulse width is adjustable over range of approximately 5 to 7 -sec. Timing is also variable
ENVIRONMENT	
OPERATING TEMPERATURE	-20°C to +55°C (-4°F to +122°F)
HUMIDITY	To 95%
MECHANICAL	
DIMENSIONS	4-1/2" W x 8" L

COHU reserves the right to change specifications without notice.

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Section II
INSTALLATION AND OPERATION

2-1. RECEIVING INSPECTION

Immediately upon receipt of equipment, inspection should be made to reveal any visible or functional damage which may have occurred in shipment. (See Form P-293-5-62-5M enclosed in the packing container.) Operational testing must be performed to ascertain whether concealed damage has been incurred in transit.

2-2. WARRANTY

Standard warranty certificate, Form No. S-212 (on the inside back cover), applies to this equipment. Instructions and conditions stated or implied in this manual are not to be interpreted in any manner which would conflict with or modify the meaning or intent of the warranty.

2-3. INSTALLATION

CAUTION

Prior to using drive generator in 3200 series camera, check notes on basic electrical assembly schematic in 3200 series manual.

The drive generator is installed by inserting in the compartment assigned to it in the enclosure, and pressing it into the enclosure until the terminals on the plug-in board firmly mesh with the corresponding terminals on the interconnection board.

2-4. POWER REQUIREMENTS

Power for the drive generator is obtained from the plug-in power supply in the enclosure. The ac power requirement for the enclosure supply is 105-125 volts, 60 Hz. The operating potentials for the pulse drive generator are listed in Table 1-1.

2-5. SIGNAL REQUIREMENTS

The source of the one required input signal — mixed sync or composite video — can be a camera output, a sync generator, or an off-the-air signal. Input waveforms are shown in Figure 1-2. Voltage levels and other specifications are listed in Table 1-1. A terminating resistor of 75 ohms must be used at the input terminal unless the line is terminated in its characteristic impedance elsewhere.

2-6. INITIAL ADJUSTMENTS

The drive generator has one front-panel control (Figure 1-1) and eight internal adjustments (Figure 4-1). The front-panel control varies the timing of the horizontal sync pulses with respect to the horizontal blanking pulses in the output signals (front-porch adjustment). Range of the control is approximately 1 to 3 μsec. The internal adjustments and their functions are listed in Table 4-1.

All output pulse amplitudes have been preset at 4.0 volts nominal. Procedures for making all adjustments except front-porch time are in Section IV. To adjust the front-porch time:

a. Apply power and the specified 525-line mixed sync or composite video signal to the pulse drive generator.

b. Connect vertical input of a dual-trace oscilloscope to the blanking and sync

output terminals. Trigger both horizontal sweeps with the blanking signal. (Refer to Figure 4-1 for locations of test points on drive generator board.)

c. Set front-porch time as desired with the front panel FRONT PORCH control (Figure 1-1). The adjustable range is approximately 1 to 3 microseconds. Standard value is 1.2 microseconds.

2-7. OPERATIONAL CHECKOUT

Operational checkout is best accomplished by installing drive generator in the camera system with which it is to be used and observing the behavior under operating conditions at a monitor. As an alternative the output signal lines may be terminated at the enclosure with 75-ohm resistors and monitored with an oscilloscope. (A checkout procedure is provided in Section IV.) With the correct input signal applied (Figure 1-2) the sync, blanking, vertical drive and horizontal drive output pulses should comply with EIA standard RS-170 specification (see waveforms in Figure 1-2).

2-8. OPERATING PROCEDURE

After the drive generator is properly seated in its enclosure:

a. Connect input jumper to correct mode (sync or video).

b. Apply power to enclosure.

c. Adjust the front-panel FRONT PORCH control as required.

Section III
CIRCUIT DESCRIPTION

3-1. SYSTEM FUNCTION

A basic closed-circuit television system (Figure 3-1) consists of a camera, camera control circuitry, drive generator (when used), and a video monitor. The transmission of useful video information depends upon synchronous performance of various circuits within the system. The drive generator furnishes pulses which trigger circuits within the camera and camera control to provide proper coincidence of currents within the deflection coils, generating the predetermined horizontal and vertical scan patterns.

3-2. DRIVE GENERATOR FUNCTIONS

As shown in Figure 3-2, the drive generator contains three main functional channels: horizontal drive, vertical drive and blanking. The sync output is derived directly from the input signal. With one input (external sync or composite video), the drive generator provides all signals required by a camera system. Waveforms shown in Figure 4-2 are keyed to test points on the overall schematic shown in Figure 3-4.

3-3. PULSE IDENTIFICATION

Four basic pulses are obtainable from the generator. These are: (1) sync, (2) H. drive, (3) V. drive and (4) blanking.

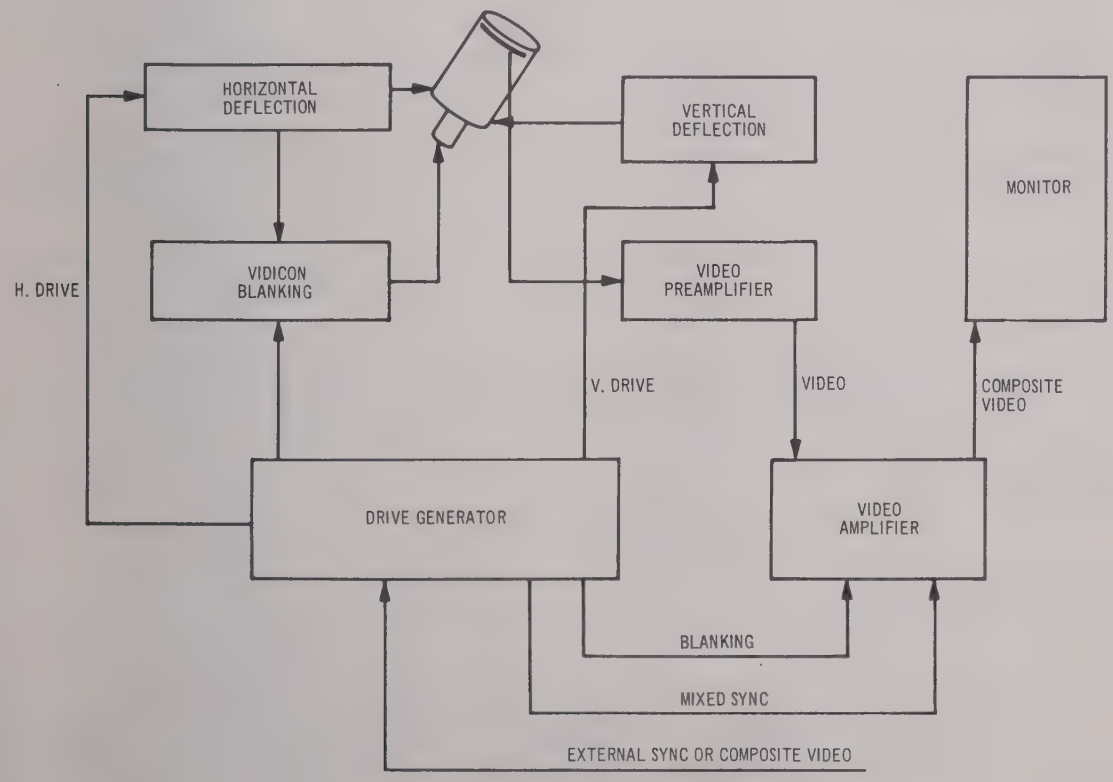


Figure 3-1. Drive Generator Application in a Typical CCTV System

Sync pulses are obtainable as an output when the generator has a composite video input. The sync signal is separated from the video, then is used in other control circuits in the camera (3200 series) or the camera control (3900 series).

Horizontal and vertical drive pulses are developed from either the sync or composite video signal, and are applied to the vidicon deflection circuits. These drive pulses are not present on the composite video output of the camera.

Blanking pulses are developed from either sync or composite video input. The blanking output is a mixed vertical and horizontal blanking signal applied to the video amplifiers, to be inserted in the video output of the camera.

3–4. CIRCUIT DETAILS

Circuits of the 3200-600 Drive Generator are described in this section according to their functions. The discussion is keyed to the block diagrams and the overall schematic, Figure 3-4.

3–5. HORIZONTAL DRIVE PULSE GENERATION

The composite video or sync input waveform (see Figure 1-2) at terminals L or F is applied to buffer Q1, a field-effect transistor. Q1 provides the required high input impedance and also drives Q2, which operates with Q3 in a 2-stage negative-feedback amplifier. Peak-to-peak amplitude of signal at output of the amplifier is set by adjustment of gain control R3, if the input signal is mixed sync. If composite video, a jumper is placed across the control, in which case the amplifier has a fixed gain.

From the output of Q3 the amplified signal, with positive-going sync, is applied to peak clipper Q5, where the video is eliminated from the signal, if composite video, by biasing the transistor so it cannot conduct except during sync times. A clamp, Q4 sets the dc level of the sync tips. The clipping level is set by the adjustment of CLIP LEVEL control R13.

Output of Q5, consisting of positive-going vertical and horizontal sync, is applied to

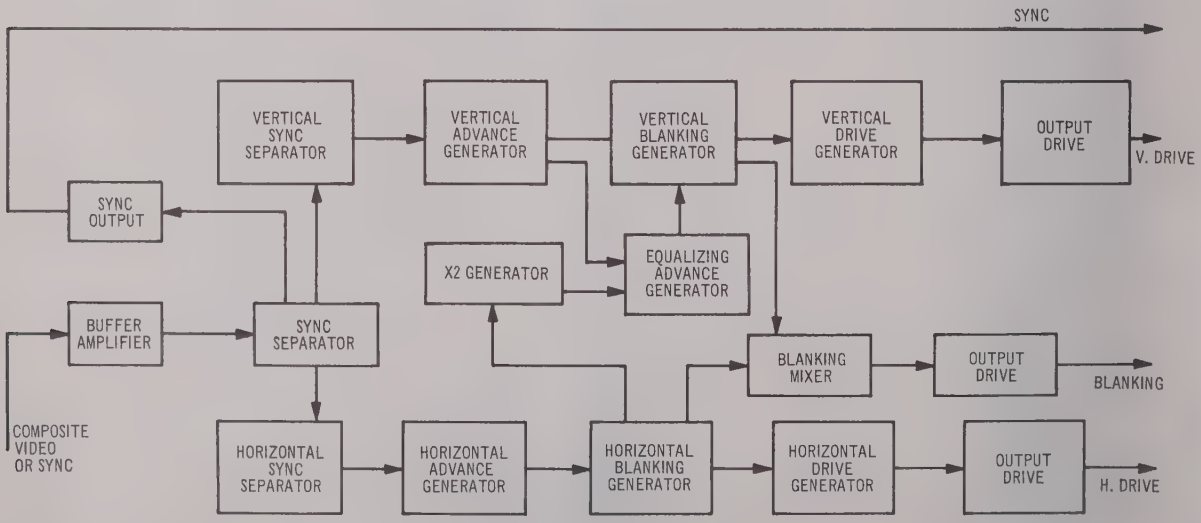


Figure 3-2. 3200-600 Drive Generator Block Diagram

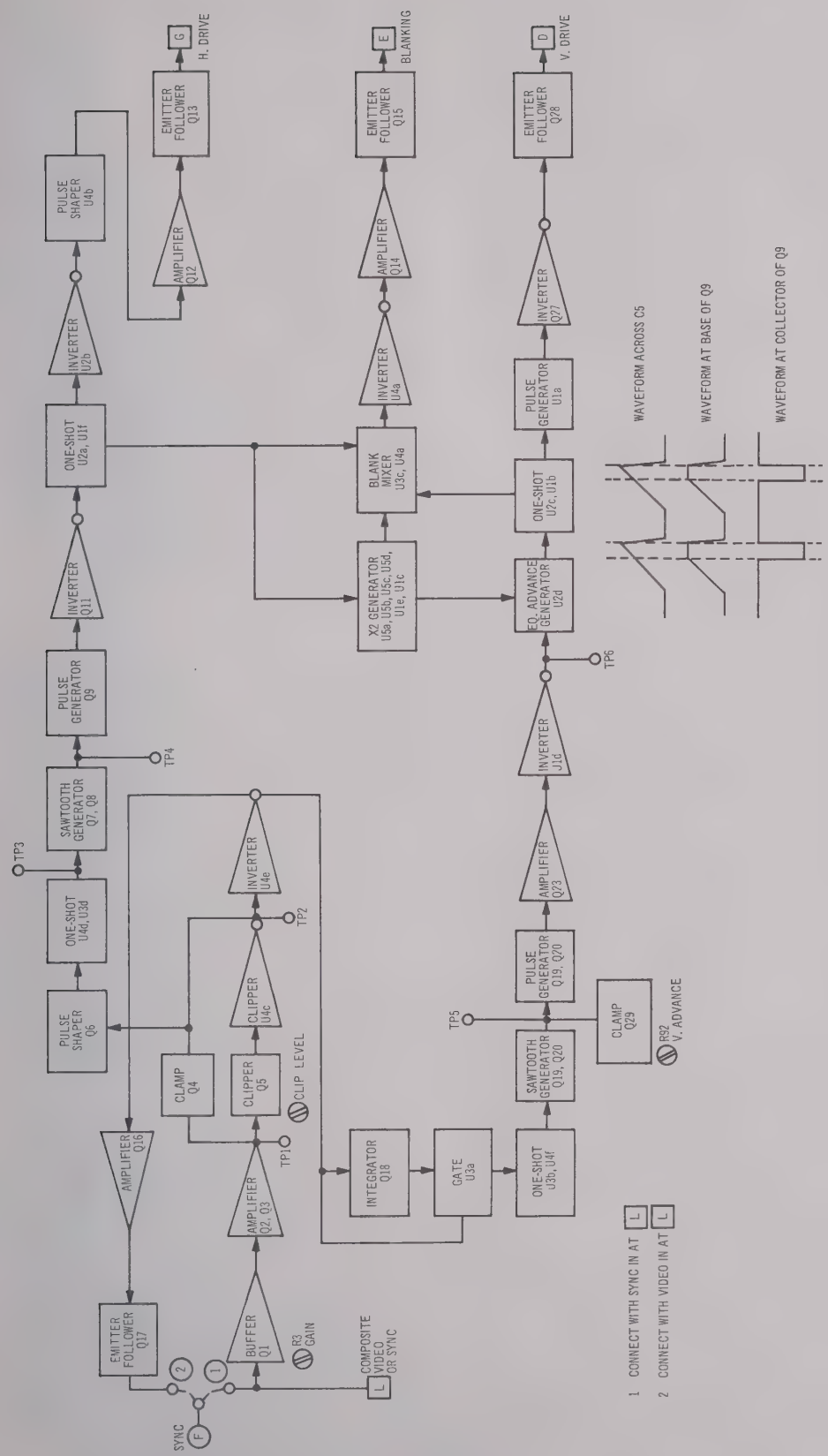


Figure 3-3. Drive Generator Detailed Block Diagram

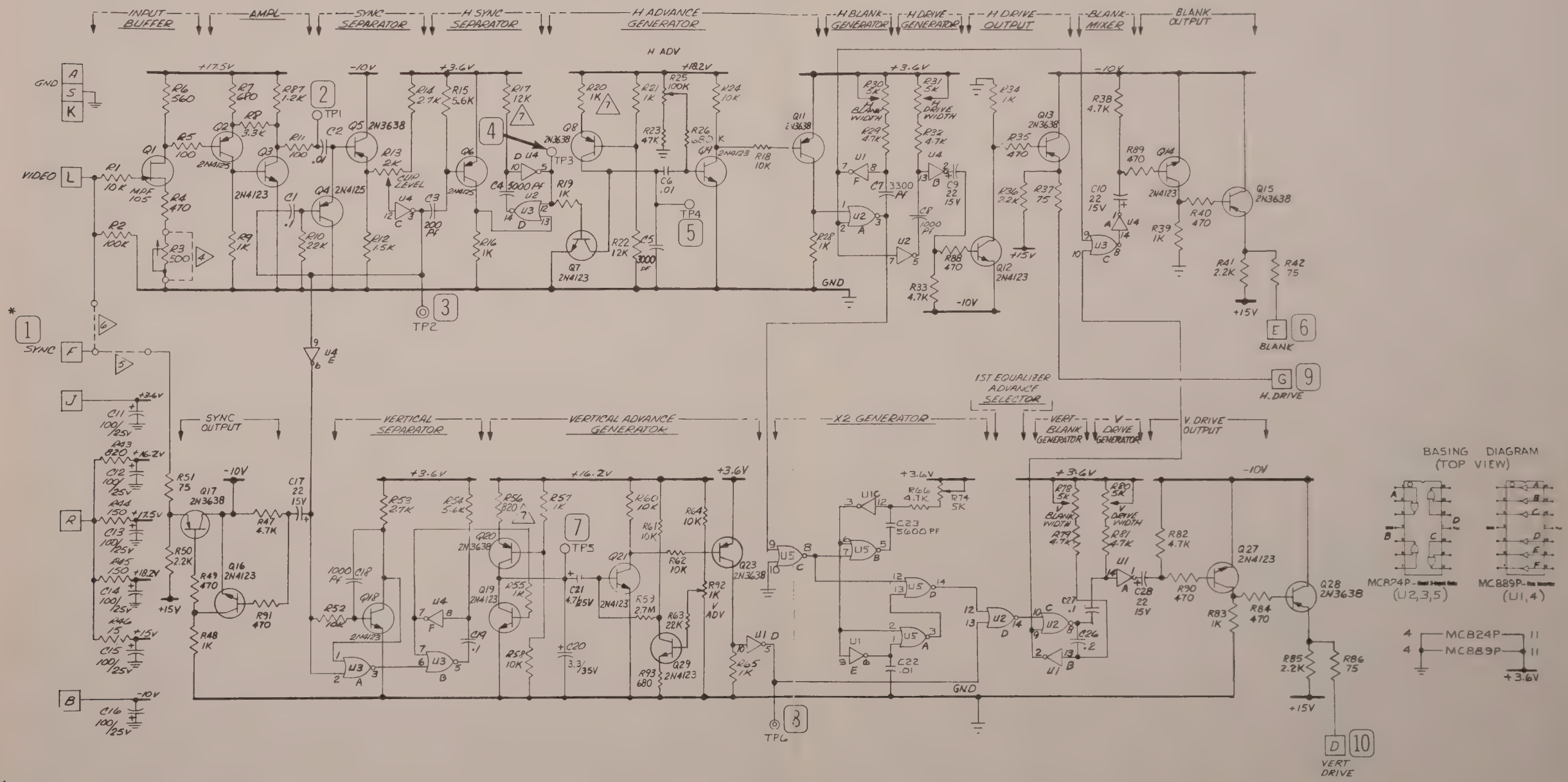
inverter U4c. In this stage the polarity of the pulses is reversed and their rise time is shortened to provide a fast-falling negative-going pulse edge. Both the horizontal and vertical sync pulses at U4c's output, drive clamp Q4 into conduction at their respective occurrence times (see paragraph 3-6). These pulses are also applied to one-shot multivibrator U4d, U3d, whose on time is set to approximately 2/3 line rate. This allows only pulses at the horizontal sync rate to trigger the one-shot.

Output from the one-shot, a positive-going pulse at the horizontal sync rate, drives sawtooth generator Q7, Q8. During pulse times Q7 conducts and discharges capacitor C5. Between pulses Q7 is cut off and the capacitor charges exponentially through Q8 and R20. The resulting signal across C5 is a sawtooth waveform with a fast-falling negative slope and a slowly rising positive slope. This signal drives Q9, a combination clamp and switch. At the base of Q9 the positive peaks of the sawtooth waveform are clamped by emitter-to-base conduction in Q9. Emitter-to-base bias on Q9 is established by the setting of R25, the FRONT PORCH control that is used to adjust the timing of horizontal blanking in the output with reference to the leading edges of horizontal sync at the input. When the clamping point is reached, emitter-to-collector conduction in Q9 causes its collector to switch from a positive to a negative level. The resulting waveform at the collector is a negative-going rectangular pulse, which occurs at the horizontal sync rate. Figure 3-3 shows the time relationship of the waveform across capacitor C5 and the waveforms at the base and collector of Q9.

Output from Q9, a negative-going rectangular pulse at the horizontal sync rate, is applied to Q11, an inverter. Q11 reverses the polarity of the pulse and provides a triggering pulse with a fast-rising positive pulse edge for one-shot U2a, U1f. When triggered, the one-shot produces both a positive-going and a negative-going rectangular pulse at the horizontal sync rate. Width of the pulses is set by R30, the H BLANK control that is used to adjust the width of horizontal blanking at the output. The negative-going pulse at the output of the one-shot is routed to the vertical drive generator section (paragraph 3-6). The positive-going output pulse is routed to the blanking output circuit (paragraph 3-7) and also to inverter U2b. At U2b the positive-going rectangular pulse is changed to a negative-going rectangular pulse. This is applied to pulse shaper U4b.

At the input of U4b a differentiating network (C8, R31) converts the leading edge of waveform into a sharp negative-going pulse edge which decays exponentially. When this pulse is present at its input U4b stops conducting and provides a positive-going rectangular pulse at its output. The leading edge of the output pulse corresponds to the leading edge of the input pulse. Width of the output pulse corresponds to the decay time of the input pulse and is set by R31. This is the H DRIVE WIDTH control that is used to adjust the width of the horizontal drive at the output.

The U4b output pulses are amplified by Q12 and converted to negative-going pulses to drive emitter follower Q13, which couples the pulses to the horizontal drive output terminal (terminal G). The emitter follower provides the required output impedance and power to drive a 75-ohm line. Waveform at the output terminal is the same as that illustrated for horizontal drive in Figure 1-2.



* KEYED TO WAVEFORMS, FIGURE 4-3

7. NOMINAL VALUE SHOWN, ACTUAL VALUE TO BE DETERMINED IN TEST.
6. CONNECT AS SHOWN FOR SYNC IN.
5. CONNECT AS SHOWN FOR VIDEO IN.
4. REMOVE JUMPER FOR SYNC

2. CAPACITOR VALUES ARE IN MICROFARADS.
1. RESISTOR VALUES ARE IN OHMS 5%, 1/4 WATT.

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 3-4. Drive Generator Schematic
(Dwg. No. 8394500)

3-6. VERTICAL DRIVE PULSE GENERATION

Negative-going vertical and horizontal sync pulses at the output of inverter U4c in the horizontal drive generator (paragraph 3-5) are converted to positive-going pulses by U4e, an inverter. They are then applied to both integrator Q18 and gate U3a. Due to the presence of a capacitor between its collector and base, Q18 responds only to the long vertical sync pulses and produces a positive-going output pulse at the vertical sync rate only. This pulse, which is rounded at the corners, is applied as a second input to gate U3a. The coincidence of the integrator output pulse and the vertical sync waveform at the output of inverter U4e enables the gate to supply a sharp positive-going output pulse at the vertical sync rate. This triggers one-shot U3b, U4f.

Output from the one-shot, a positive-going rectangular pulse at the vertical sync rate, drives sawtooth generator Q19, Q20, where a sawtooth waveform is produced with a fast-falling negative slope and a slow-rising positive slope. The negative slope is generated when Q19 conducts and discharges a capacitor (C20). The positive slope is produced by recharging the capacitor through Q20 while Q19 is cut off.

The sawtooth signal is applied through C21 to clamp-switch transistors Q21 and Q29. Transistor Q29 operates in the same manner as Q9, in the horizontal advance generator. The emitter-to-base conduction of Q21 is set by R92, controlling the bias of temperature stabilizer Q29. By so doing, R92 controls the width of the pulse applied to Q23. Transistor Q23 amplifies and inverts the negative-going pulse and applies it to inverter U1d, where the pulse is restored to a negative-going waveform, then applied to gate U2d. The frequency of the pulse at the input of U2 is 60 Hz. Also applied to gate U2d is a negative-going rectangular pulse at twice the horizontal sync rate, or 31,500 Hz. This is provided by the X2 generator U5d, U1c, U5a, U1e and U5c and is generated with negative-going pulses at the horizontal sync rate from the output of one-shot U2a, U1f in the horizontal drive generator (paragraph 3-5), after they are converted to positive-going pulses by inverter U5b. The vertical pulse enables gate U2d, producing a train of 31.5 kHz pulses at a 60-Hz rate. The first pulse triggers one-shot U2c, U1b where both a positive-going and a negative-going rectangular pulse are produced at the vertical sync rate. The positive-going pulse is routed to mixer U3c in the blanking generator section (paragraph 3-7). The negative-going pulse is applied to pulse shaper U1a. Width of both pulses is determined by setting of R78. This is the V BLANK WIDTH control that varies the width of the vertical blanking output pulses.

Pulse shaper U1a produces a positive-going output pulse during the time it is cut off by the negative-going pulse at its input terminal. The width of the pulse is determined by differentiating network C27, R80, R81. Potentiometer R80 is the V DRIVE WIDTH control that is used to vary the width of the vertical drive output pulses. Output from the pulse generator is amplified by 2-stage amplifier Q27, Q28. The emitter follower couples the pulses without changing their polarity to the vertical drive output terminal (terminal D). Waveform at the output terminal is the same as that illustrated for vertical drive in Figure 1-2.

3-7. BLANKING PULSE GENERATION

Positive-going vertical blanking pulses from one-shot U2c, U1b in the vertical drive generator (paragraph 3-6) are ap-

plied to mixer U3c along with positive-going horizontal blanking pulses from one-shot U2a, U1f in horizontal drive generator (paragraph 3-5). Output of the mixer contains both negative-going vertical blanking pulses and negative-going horizontal blanking pulses. Inverter U4a reverses the polarity of these pulses, after which they are amplified and restored to negative-going pulses by Q14 to drive emitter follower Q15. Outputs from the emitter follower are the negative-going mixed blanking pulses supplied at the blanking output terminal (terminal 5) and illustrated in Figure 1-2.

3-8. SYNC GENERATION

Negative-going horizontal and vertical sync pulses at output of inverter U4c in horizontal pulse drive generator (paragraph 3-5) are converted to positive-going pulses by inverter U4e. After inversion the pulses are amplified by Q16 and restored to the negative-going polarity to drive emitter follower Q17. Output from the emitter follower is also negative-going in polarity and is presented at the sync output terminal (terminal F). The sync output waveform is illustrated in Figure 1-2.

Section IV
MAINTENANCE

4-1. GENERAL

Information provided in this section includes instructions for: (1) locating components, (2) making corrective adjustments, and (3) diagnosing malfunctions.

4-2. LOCATING COMPONENTS

All components in the 3200-600 Drive Generator can be located with the aid of Figure 4-1. Component designations in the illustration correspond to those used in the schematic (Figure 3-4).

4-3. INTERNAL ADJUSTMENTS

The drive generator contains eight internal adjustments. Functions are listed in Table 4-1.

4-4. CORRECTIVE MAINTENANCE

All adjustments, except for the one front-panel control described in Section II, are board mounted. These controls vary the input amplifier gain, sync separation level; horizontal blanking width and timing, horizontal drive width, vertical blanking width and timing and vertical drive width. To make these adjustments a dual-trace calibrated laboratory oscilloscope, such as Tektronix 535, is required. Refer to Figure 4-2 for typical waveforms at the test points indicated in the following procedure:

a. Place pulse drive generator assembly on a card extender and install the card extender into the plug-in receptacle assigned to the pulse drive generator in the 3200 camera or 3900 camera control enclosure.

b. Set POWER switch on enclosure power supply to ON and apply a 2 to 8 volt mixed sync signal to the EXT input terminal on rear of enclosure. The appropriate sync input waveform is shown in Figure 1-2. Typical pulse rates and durations for this input waveform are listed in Table 4-2.

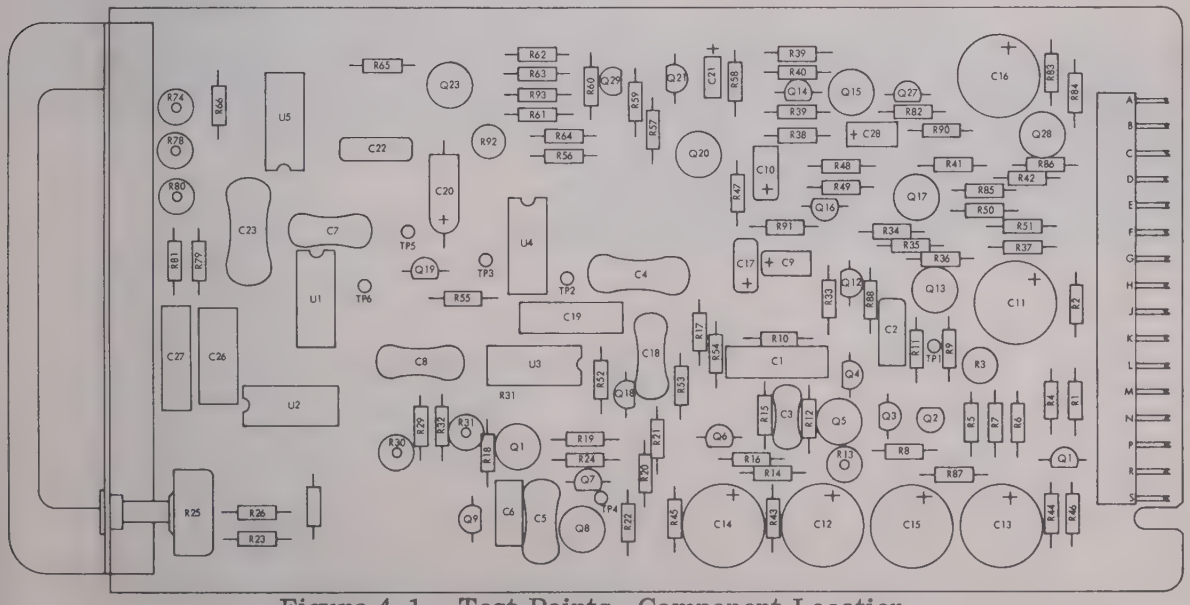
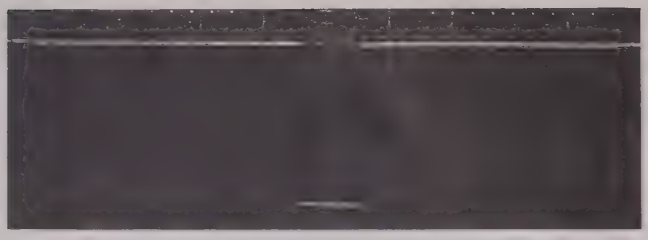
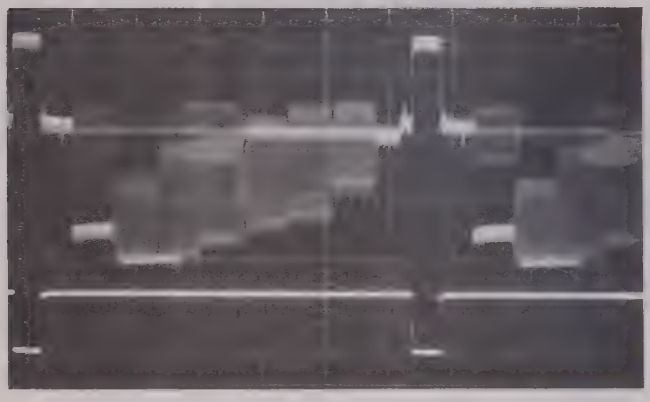


Figure 4-1. Test Points, Component Location



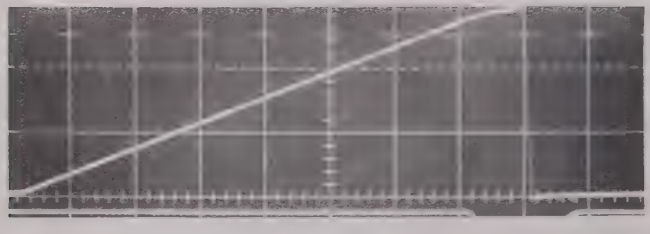
1 2V/cm; 0.2 ms/cm



2 1V/cm; 10 µs/cm

3 2V/cm; 10 µs/cm

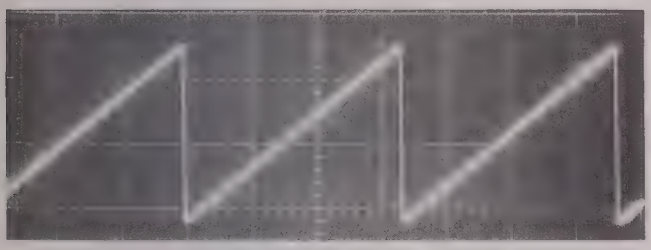
4 1V/cm; 10 µs/cm



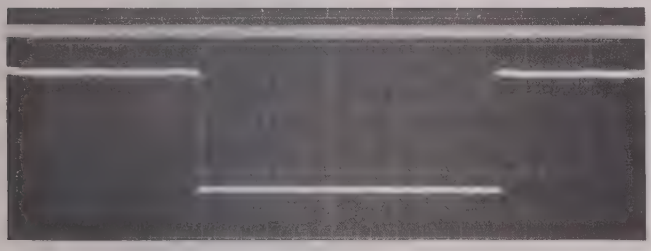
5 2V/cm; 2 µs/cm

Figure 4-2. Drive Generator Waveforms

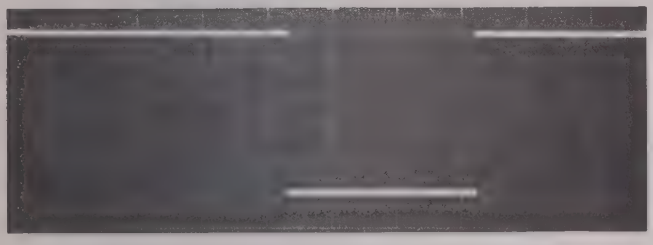
6
9 2V/cm; 0.5 ms/cm



7 0.2V/cm; 5 ms/cm



8 1V/cm; 50 μs/cm



10 2V/cm; 0.2 ms/cm

Figure 4-2. Drive Generator Waveforms (Contd)

Table 4-1. Internal Adjustments

DESIGNATION	FUNCTION
R3	Sets gain of input signal buffer amplifier
R13 (CLIP LEVEL)	Establishes input waveform dc level which separates sync from composite video signal
R30 (H-BLANK WIDTH)	Varies width of horizontal blanking pulses over range of approximately 10 to 12 μsec. Factory set for 11 μsec
R31 (H-DRIVE WIDTH)	Varies width of horizontal drive pulses over range of approximately 5 to 7 μsec. Factory set for 6.35 μsec
R92 (V ADV)	Adjusts vertical drive pulse timing
R74	Adjusts X2
R78 (V-BLANK WIDTH)	Varies width of vertical blanking. Factory set for 21H lines
R80 (V-DRIVE WIDTH)	Varies width of vertical drive pulses. Factory set for 9H lines

Table 4-2. Required Pulse Rates and Durations for Input Sync Signal

		PULSE DURATION				
		RELATED TO TIME REQUIRED FOR ONE HORIZ. TRACE (H)*		IN MICROSECONDS		
PULSE	PULSE RATE	MIN.	MAX.	MIN.	NOM.	MAX.
H. Sync	15,750	.070 H	.080 H	4.45	4.76	5.08
H. Blank	15,750	.165 H	.178 H	10.50	11.00	11.30
Equalizing	31,500	.035 H	.045 H	2.20	2.50	2.80
V. Sync	31,500	.420 H	.440 H	26.67	27.25	28.10
V. Serration	31,500	.061 H	.079 H	3.85	4.45	5.05
V. Blank	60	(21 H nominal)		(1333 nominal)		
Front Porch Width: 1.2 μsec min.						
Pulse Rise Time: 0.14 μsec.						
*H = 63.5 μsec.						

c. Connect oscilloscope vertical amplifier to TP1 (Figure 4-1). Also disconnect VIDEO ONLY jumper (Figure 4-1) from across R3, if one is there.

d. Adjust R3, if necessary, to produce a 3-volt peak-to-peak waveform at test point.

e. Connect vertical amplifier of oscilloscope to TP2 (Figure 4-1) and adjust R13 (Figure 4-1), if necessary, until sync is present at the test point.

R. f. To TP3 on Fig. 3-4

f. Connect vertical amplifier of oscilloscope to TP3 (Figure 4-1). A positive-going sawtooth waveform at horizontal line rate with a width equal to 2/3 the horizontal line time should appear at this point.

g. Connect vertical amplifier of oscilloscope to TP4 (Figure 4-1). Check for sawtooth waveform at horizontal sync rate with peak-to-peak amplitude of 5.5 volts ±0.5 volt.

h. Connect vertical inputs of oscilloscope to blanking and sync output terminals (E and F, Figure 4-1). Delay between start of horizontal sync and start of horizontal blanking (front porch) should be between 1 and 3 microseconds. Check width of horizontal blanking, which should be between 10 and 12 microseconds. If not, adjust R30 (Figure 4-1) for approximately 11 microseconds.

i. Connect vertical amplifier of oscilloscope to horizontal drive output terminal (G, Figure 4-1). A negative-going rectangular pulse at horizontal line rate with a duration between 5 and 7 microseconds should appear at this point. If duration is otherwise, adjust R31 (Figure 4-1) for approximately 6 microseconds.

j. Connect vertical deflection of oscilloscope to TP5 (Figure 4-1). A sawtooth waveform at the vertical sync rate should appear at this point. Peak-to-peak amplitude should be 5.5 volts ±0.5 volts.

k. Connect vertical amplifier of oscilloscope to TP6 (Figure 4-1) and sync output terminal (F, Figure 4-1). The positive-going 60 pps rectangular pulse at TP6 should lead first equalizing pulse by time of 1/4 horizontal line. If not, adjust R92 (Figure 4-1).

l. Connect both vertical inputs of oscilloscope to vertical drive output terminal (D, Figure 4-1). Set oscilloscope for alternate sweeps. Trigger delayed sweep from the vertical drive. Set delayed sweep for 5 ms/cm. Set main sweep for 10 μs/cm. Find leading edge of vertical drive pulse and adjust delayed sweep length so that alternate fields are displayed. The leading edges of pulses for both displays should coincide. If not, adjust R74 (Figure 4-1).

m. Connect vertical amplifier of oscilloscope to blanking and sync output terminals (E and F, Figure 4-1). Vertical blanking should have a duration of 21 horizontal lines. If not, adjust R78 (Figure 4-1). Check that vertical blanking starts approximately 1.7 microseconds before first equalizing pulse.

n. Connect vertical input of oscilloscope to vertical drive output terminal (D, Figure 4-1). Duration of vertical drive pulse should be equal to 9 horizontal lines. If not, adjust R80 (Figure 4-1).

o. Install the VIDEO ONLY jumper across R3 (Figure 4-1) and apply a 1-volt composite video signal (see Figure 1-2) to the EXT input connector on rear of enclosure.

p. Connect vertical amplifier of oscilloscope to TP2 (Figure 4-1). Adjust R13 (Figure 4-1) to a point approximately halfway between where video first appears and the point where amplitude of the sync starts to reduce.

4-5. REPAIR

The drive generator should require no maintenance other than proper care in handling and use. Should it become necessary to repair the unit, plug it into a card extender, then plug the card extender into the assigned compartment of the enclosure so testing can be done with test points and board-mounted controls accessible. A troubleshooting guide is provided in Table 4-3.

Table 4-3 is based on the presumption that the correct input signal and power supply voltages are present at the input terminals on the drive generator board. To check these a calibrated laboratory oscilloscope and a 0-25 volt dc meter are required. The procedure is as follows:

a. Disconnect any other plug-in accessories that are in the enclosure. Do not disconnect the plug-in power supply.

b. Measure the power supply voltages at terminals B, R and J (Figure 4-1). Use terminal A, S, or K for the ground return. At terminal B the voltage should be -10 volts ±2%. At terminal R the voltage should be +20 volts ±2%, and at terminal J it should be +3.6 volts ±3%. If any of these voltages are incorrect check the power supply in the enclosure, as outlined in the 3200 camera or 3900 camera control manual.

c. Check the sync or composite video input signal at terminal F or L. Use terminal A, S, or K for the ground return. Composite video should have negative-going sync and a peak-to-peak amplitude between 0.7 and 1.0 volt as illustrated in Figure 1-2. If sync is being used instead of composite video the sync waveform should be as shown in Figure 1-2 and have a peak-to-peak amplitude between 2 and 8 volts.

4-6. REPLACEMENT PARTS

Replacement parts which can be obtained from the factory are listed in Table 4-4. Part designations in the table correspond to those used in the schematic (Figure 3-4) and in the component location diagram (Figure 4-1). When ordering parts include the part numbers listed in the table.

Table 4-3. Troubleshooting Guide

SYMPTOM	PROBABLE CAUSE	CHECK
All outputs missing (see waveforms in Figure 1-2)	Defective horizontal drive generator (paragraph 3-5)	U4c, Q5, Q4, Q3, Q2, Q1
Sync, vertical drive and vertical blanking outputs missing	Defective inverter (paragraph 3-6)	U4e
Vertical blanking, vertical drive, horizontal blanking and horizontal drive missing from output	Defective horizontal blanking generator (paragraph 3-5)	U2a, U1f, Q11, Q9, Q8, Q7, U3d, U4d, Q6
Vertical drive and vertical blanking outputs missing	Defective vertical drive generator (paragraph 3-6)	U1b, U2c, U2d, U6c, U6a, U1e, U6d, U1c, U6b, U1d, Q23, Q29, Q21, Q20, Q19, U3b, U4d, Q6
Horizontal blanking output missing or is of poor quality	Defective mixer in blanking generator (paragraph 3-7)	U3c
Horizontal drive output missing or is of poor quality	Defective horizontal drive generator (paragraph 3-5)	Q13, Q12, U4b, U2b
Sync output missing or is of poor quality	Defective sync output amplifier (paragraph 3-8)	Q17, Q16
Vertical drive output missing or is of poor quality	Defective vertical drive generator (paragraph 3-6)	Q28, Q27, U5d, U5b and U1a
Both vertical and horizontal blanking outputs missing of of poor quality	Defective blanking generator (paragraph 3-7)	Q15, Q14, U4a, U3c

Table 4-4. List of Replacement Parts, 3200-600 Drive Generator

CIRCUIT REF.		DESCRIPTION	COHU PART NO.
A	1	CIRCUIT BOARD, DRIVE GENERATOR	8394501-001
C	1	CAPACITOR, MYLAR, .10UF, 200V	0610133-019
C	2	CAPACITOR, MYLAR, .01UF, 200V	0610133-007
C	3	CAPACITOR, SILVER MICA, 200PF, 500V	1010006-201
C	4	CAPACITOR, SILVER MICA, 5000PF, 500V	1010008-502
C	5	CAPACITOR, SILVER MICA, 3000PF, 500V	1010007-302
C	6	CAPACITOR, MYLAR, .01UF, 200V	0610133-007
C	7	CAPACITOR, SILVERED MICA, 3300PF, 500V	1010007-332
C	8	CAPACITOR, SILVER MICA, 1000PF, 500V	1010007-102
C	9	CAPACITOR, TANTALUM, 22UF, 15V	0510135-006
C	10	CAPACITOR, TANTALUM, 22UF, 15V	0510135-006
C	11	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	12	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	13	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	14	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	15	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	16	CAPACITOR, ELECTROLYTIC, 100 UF, 25V	0510093-030
C	17	CAPACITOR, TANTALUM, 22UF, 15V	0510135-006
C	18	CAPACITOR, SILVER MICA, 1000PF, 500V	1010007-102
C	19	CAPACITOR, MYLAR, .10UF, 200V	0610133-019
C	20	CAPACITOR, TANTALUM, 3.3UF, 35V	0510151-117
C	21	CAPACITOR, TANTALUM, 4.7UF, 25V	0510135-020
C	22	CAPACITOR, FILM DIELECTRIC, 0.01UF, 100V	0610136-103
C	23	CAPACITOR, SILVER MICA 5600 PF, 500V	1010009-562
C	26	CAPACITOR, MYLAR, .2UF, 50V	0610043-026
C	27	CAPACITOR, MYLAR, .10UF, 200V	0610133-019
C	28	CAPACITOR, TANTALUM, 22UF, 15V	0510135-006
Q	1	TRANSISTOR, FIELD EFFECT	7210084-001
Q	2	TRANSISTOR, TYPE 2N4125	7210064-009
Q	3	TRANSISTOR, TYPE 2N4123	7210064-008
Q	4	TRANSISTOR, TYPE 2N4125	7210064-009
Q	5	TRANSISTOR, TYPE 2N3638	7210069-001
Q	6	TRANSISTOR, TYPE 2N4125	7210064-009
Q	7	TRANSISTOR, TYPE 2N4123	7210064-008
Q	8	TRANSISTOR, TYPE 2N3638	7210069-001
Q	9	TRANSISTOR, TYPE 2N4123	7210064-008
Q	11	TRANSISTOR, TYPE 2N3638	7210069-001
Q	12	TRANSISTOR, TYPE 2N4123	7210064-008
Q	13	TRANSISTOR, TYPE 2N3638	7210069-001
Q	14	TRANSISTOR, TYPE 2N4123	7210064-008
Q	15	TRANSISTOR, TYPE 2N3638	7210069-001
Q	16	TRANSISTOR, TYPE 2N4123	7210064-008
Q	17	TRANSISTOR, TYPE 2N3638	7210069-001
Q	18	TRANSISTOR, TYPE 2N4123	7210064-008
Q	19	TRANSISTOR, TYPE 2N4123	7210064-008
Q	20	TRANSISTOR, TYPE 2N3638	7210069-001
Q	21	TRANSISTOR, TYPE 2N4123	7210064-008
Q	23	TRANSISTOR, TYPE 2N3638	7210069-001
Q	27	TRANSISTOR, TYPE 2N4123	7210064-008
Q	28	TRANSISTOR, TYPE 2N3638	7210069-001

Table 4-4. List of Replacement Parts, 3200-600 Drive Generator (Contd)

CIRCUIT REF.	DESCRIPTION	COHU PART NO.
Q 29	TRANSISTOR, TYPE 2N4123	7210064-008
R 1	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 2	RESISTOR, CARBON, 1/4W, 5%, 100 KILOHM	4045000-104
R 3	RESISTOR, VARIABLE, .5W, 500 OHM	5010097-001
R 4	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 5	RESISTOR, CARBON, 1/4W, 5%, 100 OHM	4045000-101
R 6	RESISTOR, CARBON, 1/4W, 5%, 560 OHM	4045000-561
R 7	RESISTOR, CARBON, 1/4W, 5%, 680 OHM	4045000-681
R 8	RESISTOR, CARBON, 1/4W, 5%, 3.3 KILOHM	4045000-332
R 9	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 10	RESISTOR, CARBON, 1/4W, 5%, 22 KILOHM	4045000-223
R 11	RESISTOR, CARBON, 1/4W, 5%, 100 OHM	4045000-101
R 12	RESISTOR, CARBON, 1/4W, 5%, 1.5 KILOHM	4045000-152
R 13	RESISTOR, VARIABLE, .5W, 2 KILOHM	5010097-004
R 14	RESISTOR, CARBON, 1/4W, 5%, 2.7 KILOHM	4045000-272
R 15	RESISTOR, CARBON, 1/4W, 5%, 5.6 KILOHM	4045000-562
R 16	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 17	RESISTOR, CARBON, 1/4W, 5%, 12 KILOHM	4045000-123
R 18	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 19	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 20	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 21	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 22	RESISTOR, CARBON, 1/4W, 5%, 12 KILOHM	4045000-123
R 23	RESISTOR, CARBON, 1/4W, 5%, 47 KILOHM	4045000-473
R 24	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 25	RESISTOR, VARIABLE, .2W, 100 KILOHM	5010071-058
R 26	RESISTOR, CARBON, 1/4W, 5%, 680 KILOHM	4045000-684
R 28	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 29	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 30	RESISTOR, VARIABLE, .5W, 5 KILOHM	5010097-005
R 31	RESISTOR, VARIABLE, .5W, 5 KILOHM	5010097-005
R 32	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 33	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 34	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 35	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 36	RESISTOR, CARBON, 1/4W, 5%, 2.2 KILOHM	4045000-222
R 37	RESISTOR, CARBON, 1/4W, 5%, 75 OHM	4045000-750
R 38	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 39	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 40	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 41	RESISTOR, CARBON, 1/4W, 5%, 2.2 KILOHM	4045000-222
R 42	RESISTOR, CARBON, 1/4W, 5%, 75 OHM	4045000-750
R 43	RESISTOR, CARBON, 1/4W, 5%, 820 OHM	4045000-821
R 44	RESISTOR, CARBON, 1/4W, 5%, 150 OHM	4045000-151
R 45	RESISTOR, CARBON, 1/4W, 5%, 150 OHM	4045000-151
R 46	RESISTOR, CARBON, 1/4W, 5%, 15 OHM	4045000-150
R 47	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 48	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 49	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 50	RESISTOR, CARBON, 1/4W, 5%, 2.2 KILOHM	4045000-222

Table 4-4. List of Replacement Parts, 3200-600 Drive Generator (Contd)

CIRCUIT REF.	DESCRIPTION	COHU PART NO.
R 51	RESISTOR, CARBON, 1/4W, 5%, 75 OHM	4045000-750
R 52	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 53	RESISTOR, CARBON, 1/4W, 5%, 2.7 KILOHM	4045000-272
R 54	RESISTOR, CARBON, 1/4W, 5%, 5.6 KILOHM	4045000-562
R 55	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 56	RESISTOR, CARBON, 1/4W, 5%, 820 OHM	4045000-821
R 57	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 58	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 59	RESISTOR, CARBON, 1/4W, 5%, 2.7 MEGOHM	4045000-275
R 60	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 61	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 62	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 63	RESISTOR, CARBON, 1/4W, 5%, 22 KILOHM	4045000-223
R 64	RESISTOR, CARBON, 1/4W, 5%, 10 KILOHM	4045000-103
R 65	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 66	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 74	RESISTOR, VARIABLE, .5W, 5 KILOHM	5010097-005
R 78	RESISTOR, VARIABLE, .5W, 5 KILOHM	5010097-005
R 79	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 80	RESISTOR, VARIABLE, .5W, 5 KILOHM	5010097-005
R 81	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 82	RESISTOR, CARBON, 1/4W, 5%, 4.7 KILOHM	4045000-472
R 83	RESISTOR, CARBON, 1/4W, 5%, 1.0 KILOHM	4045000-102
R 84	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 85	RESISTOR, CARBON, 1/4W, 5%, 2.2 KILOHM	4045000-222
R 86	RESISTOR, CARBON, 1/4W, 5%, 75 OHM	4045000-750
R 87	RESISTOR, CARBON, 1/4W, 5%, 1.2 KILOHM	4045000-122
R 88	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 89	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 90	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 91	RESISTOR, CARBON, 1/4W, 5%, 470 OHM	4045000-471
R 92	RESISTOR, VARIABLE, .5W, 1 KILOHM	5010097-003
R 93	RESISTOR, CARBON, 1/4W, 5%, 680 OHM	4045000-681
U 1	INTEGRATED CIRCUIT, HEX INVERTER	3610016-001
U 2	INTEGRATED CIRCUIT, QUAD 2-INPUT GATE	3610015-001
U 3	INTEGRATED CIRCUIT, QUAD 2-INPUT GATE	3610015-001
U 4	INTEGRATED CIRCUIT, HEX INVERTER	3610016-001
U 5	INTEGRATED CIRCUIT, QUAD 2-INPUT GATE	3610015-001

WARRANTY

Cohu Electronics, Inc., warrants equipment manufactured to be free from defects of material and workmanship. Any part or parts will be repaired or replaced when proven by COHU examination to have been defective within one year (90 days for batteries, fuses, transistors and tubes) from date of shipment to the original purchaser. All warranty repairs will be performed at the factory or as otherwise authorized by COHU in writing. Transportation charges shall be prepaid by purchaser.

This warranty does not extend to COHU equipment subjected to misuse, accident, neglect or improper application, nor repaired or altered by other than COHU or those authorized by COHU in writing.

This warranty is in lieu of all other warranties express or implied. COHU shall not be liable for collateral or consequential damages.

For customer convenience, service departments are maintained throughout the United States by COHU Field Engineering Representatives.

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